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Piezoelectric strain tuned magnetic sensor

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Anisotropic magnetoresistive sensors with high sensitivity and stability have been widely used in various industrial applications, including navigation, current sensing, position and rotation sensing, and biosensing. Traditional linear anisotropic magnetoresistive sensors used barber-pole electrodes to rotate the current direction by 45 degree in order to obtain a linear electrical output as a function of external magnetic field. However, the adoption of barber-pole electrodes greatly reduced the working area of the sensor, i.e., the part of strip beneath the barber-pole electrodes could not contribute to the magnetoresistive signal.

Here we report an anisotropic magnetoresistive sensor with antiferromagnetic layer to regulate the magnetization-current angle instead of barber pole electrodes. The proposed sensor design, thereby, could fully use the magnetostrictive area, and the stabilized magnetization could help suppressing magnetic noise, enhancing stability and improving linearity. Moreover, we have fabricated AMR sensors on piezoelectric PMN-PT single crystals to investigate the strain effect on the magnetoresistance of the sensor. With strain tunable magnetic permeability and therefore the sensitivity of the magnetic sensor, we have demonstrated a novel magnetic sensor with tunable measurement range and tunable sensitive direction.